# THE SCIENCE AND TECHNOLOGICAL INNOVATION SYSTEM OF CUBA: THE CHALLENGES FACED IN THE CONTEXT OF GLOBALISATION

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## OBJECTIVE OF THE PAPER

- ✓ To describe how the gradual implementation of the Science and Technological Innovation System (SCIT) is leading the country to the modernisation of its economy and its integration in the international market.

## To get this……

- ✓ Theoretical approach to NIS
- ✓ Evolution of S&T in Cuba
- ✓ The SCTI
- ✓ Reorganization of the SCTI
- ✓ Conclusions

# THEORETICAL APPROACH TO NIS

- A close revision of the current literature on NIS reveals that there are three different approaches to NIS developed separately (Wang et al., 2012):

  - ✓ The **structural approach** focuses on identifying structural elements, including corporate behaviour, that influence innovative performance within a system (Nelson, 1993; Lundvall, 2007).

  - ✓ The **functional approach** concentrates on how various functions are served by the system (setting up IPR protection; mobilizing resources; providing knowledge) (Hekkert et al.; 2007).

  - ✓ The **effectiveness approach** takes into account the complex nature of NIS where most actors and elements are "socially embedded" and the mechanisms used to co-ordinate them are non-market mechanisms: institutional, networking and policy (Niosi, 2002).

- Recently, the Centre for Management and Strategic Studies in Brazil (2012) placed the emphasis on the importance of appropriately selects the approaches of NIS, on the basis of which S&T policies are designed, and proposed two different models:

  - ✓ The **first model** limits the innovation system to R&D activities and associated infrastructures (it is often aimed at technological developments in advanced areas such as biotechnology and nanotechnology).

  - ✓ The **second model** assumes that innovation is an interactive process in which social, political, institutional and cultural factors come together, and emphasises interactions between players in order to generate, acquire, disseminate and use knowledge.

- The application of the NIS concept to **developing countries** has been gradual and has coincided with a move away from macro-interpretations to an emphasis on micro-level interactions and processes.

- In Latin America, a fundamental problem is that the micro-innovative strengths, that really exist, often remain isolated and encapsulated, thus weakening remarkably their potential contribution to the competitiveness (Arocena and Sutz, 2005).

# EVOLUTION OF S&T IN CUBA

- **First phase (1960-1976) – Guided promotion of science**

  - ✓ An extraordinary emphasis on the creation of scientific institutions and training of the researchers (García-Capote, 1996; Castro Díaz-Balart, 2002).

- **Second phase (1976-1991) – Centralized management model**

  - ✓ Identification of "research problems" and orientate research at priority issues and the use of results in the field of production (Fernández, 1998).

  - ✓ Technology policy was also distinguished by the widespread import of technologies, most of them from Eastern European countries.

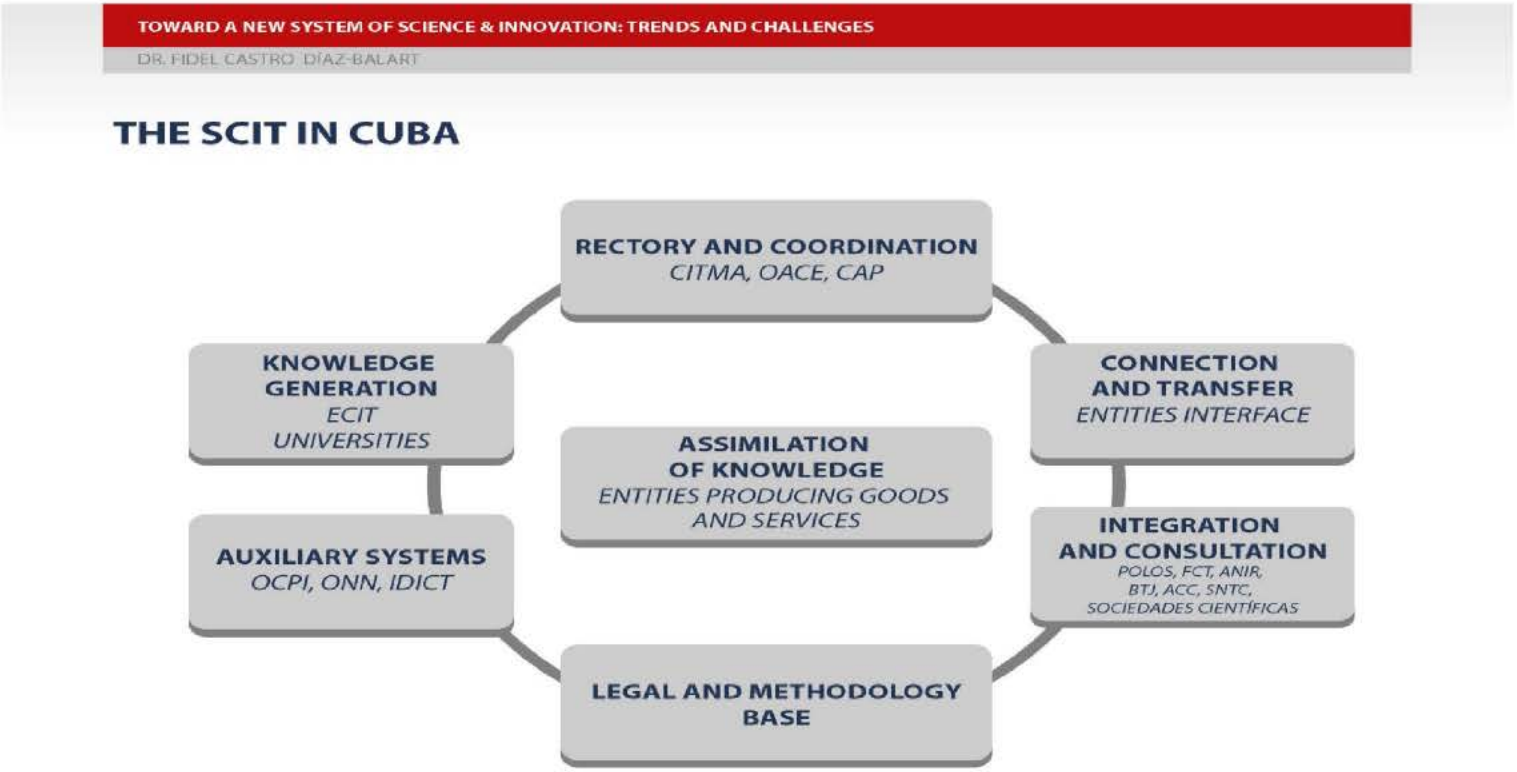
- **Third phase (1991 - to date) – Emphasis on innovation**

  - ✓ To achieve greater links between S&T activities and the production sectors, aiming to integrate the main players in innovation by means of a Science and Technological Innovation System (SCIT) (CITMA, 1995).

# THE SCIT

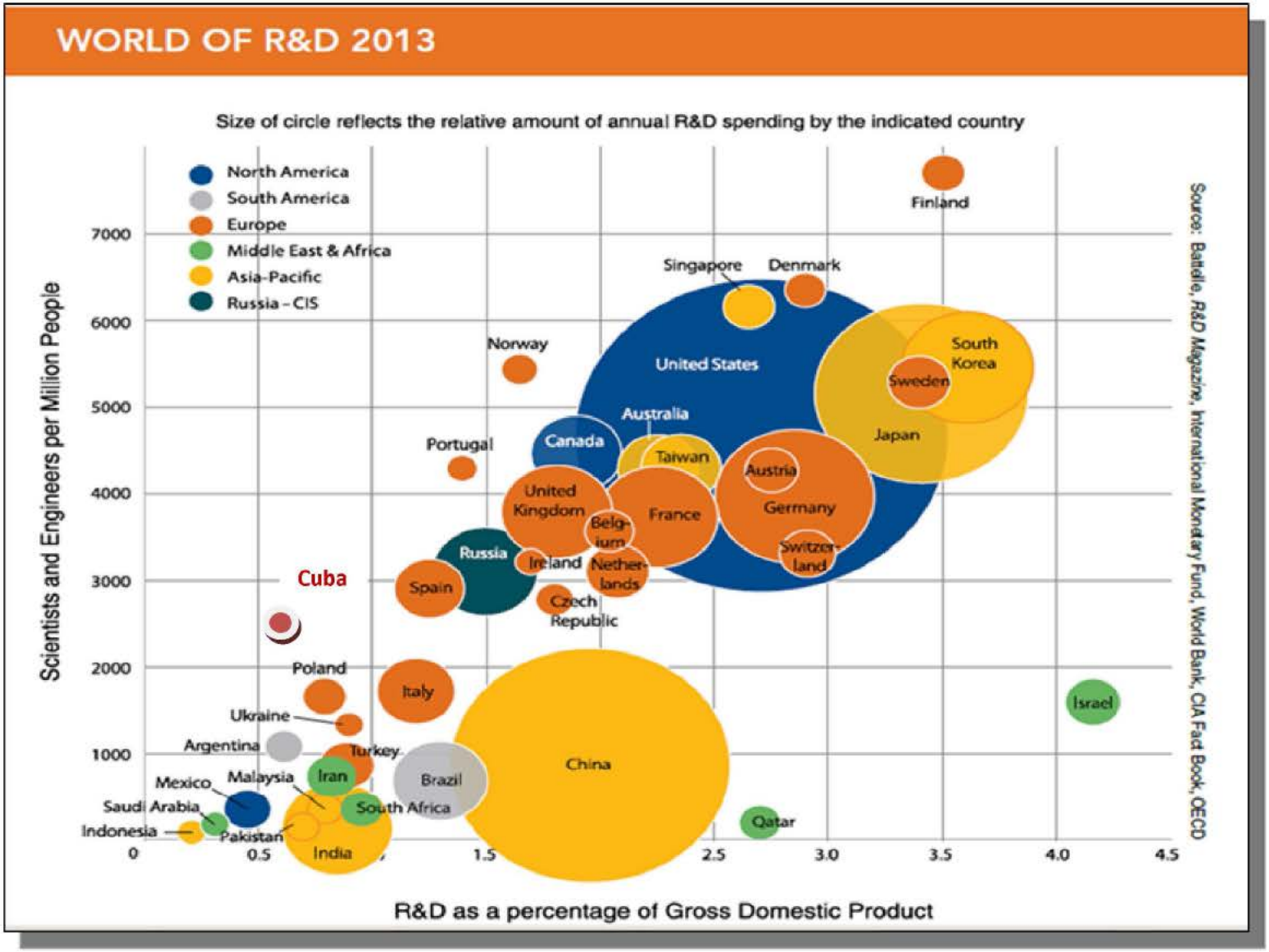
- Its implementation began in 1994 following the creation of the Ministry of Science, Technology and Environment (CITMA).

- The main reason for the change from a S&T system to a SCTI lays in the understanding that it is not enough to merely generate technologies; they must also be incorporated into social practice.



## ➢ Interface entities

- ✓ Science-Production Centers (established on a thematic and regional basis and spread throughout the country).
- ✓ Nacional Science and Technology Forum (an space in which extensive social participation in innovation processes is promoted).
- ✓ Academy of Sciences (acts as the representative of the national scientific community and the government's main advisor on scientific strategy and its coherence with national development goals).
- ✓ National Association of Innovators and Rationalisers (covers the whole production network, and is composed by companies, factories, industries, teaching and research service centres).
- ✓ Technical Youth Brigades (a movement for the participation of young people in the search for solutions to problems which usually require scientific and technological knowledge).
- ✓ Scientific societies (non-government organizations that contributes with the direct participation of professionals, technicians and workers through their respective areas of knowledge and expertise in the analysis and proposal of solutions).
- ✓ Financial institutions (offer different types of financing with the aim of strengthening the capacities of the key players in the system - Cuban Central Bank, Investments Bank, International Trade Bank and International Finance Bank).




Source: World Bank and CITMA, 2015.

# REORGANIZATION OF THE SCIT

- In recent years, the international environment has been characterized by the existence of a systemic structural crisis which is simultaneously affecting the economic, financial, energy, food and environmental areas, with a greater impact on developing countries.

- This new context has a major impact on innovation policies in Cuba, which is why the **313 Economic and Social Guidelines** were approved in 2011, marking a shift in the country's development strategies. In particular, in the area of Science, Technology and Innovation Policy a total of 11 guidelines were drawn up.

- In order to partly implement these strategic objectives, on 29 August 2014 **Government Decree 323 on "Science, Technology and Innovation Entities"** was approved, with the aim to ensure a more efficient management of science, technology and innovation.

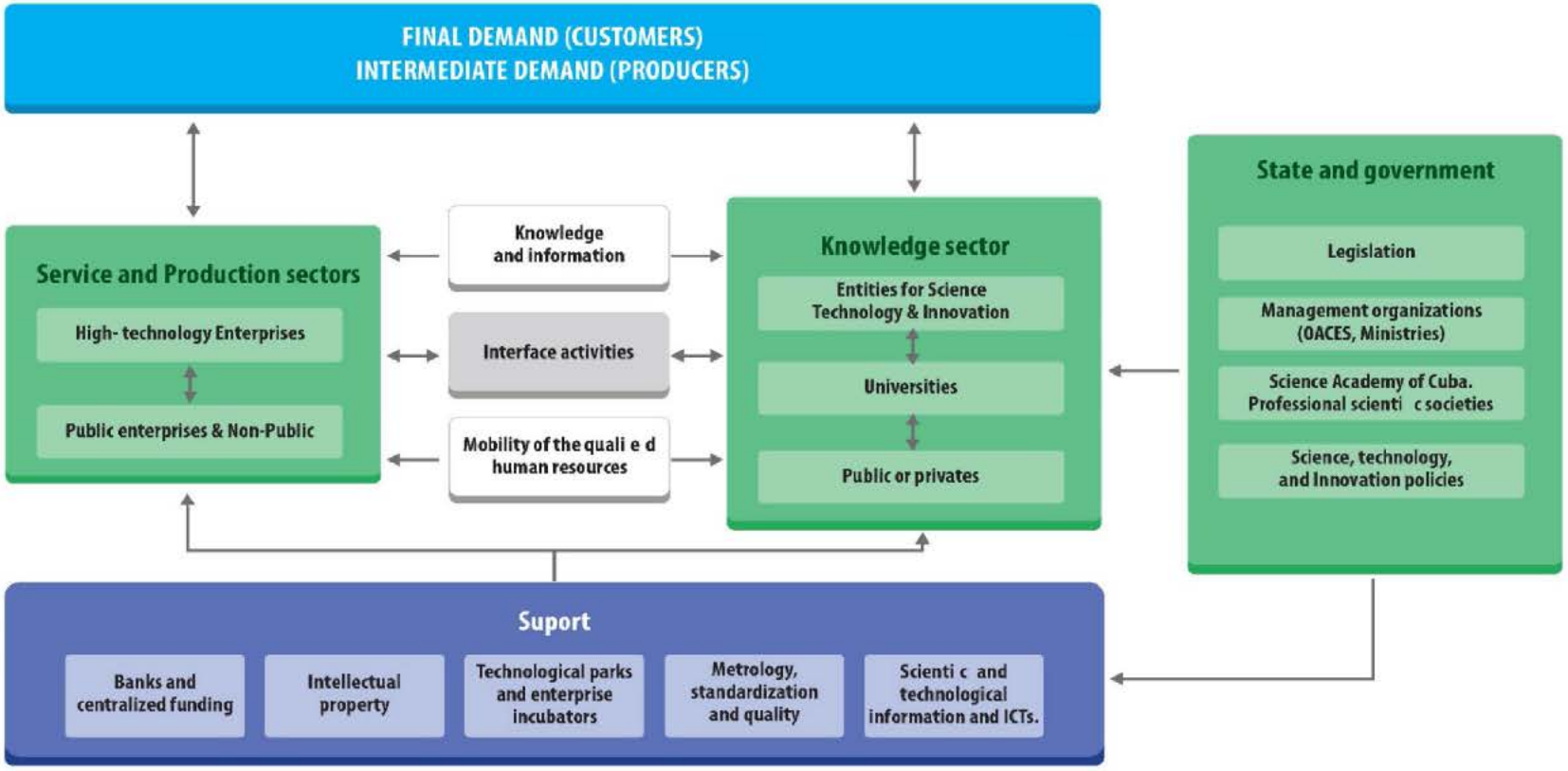
- Consequently, the following provisions have been updated:

  - ✓ The organization and operation of the National Science, Technology and Innovation Register (Resolution 164/2014).

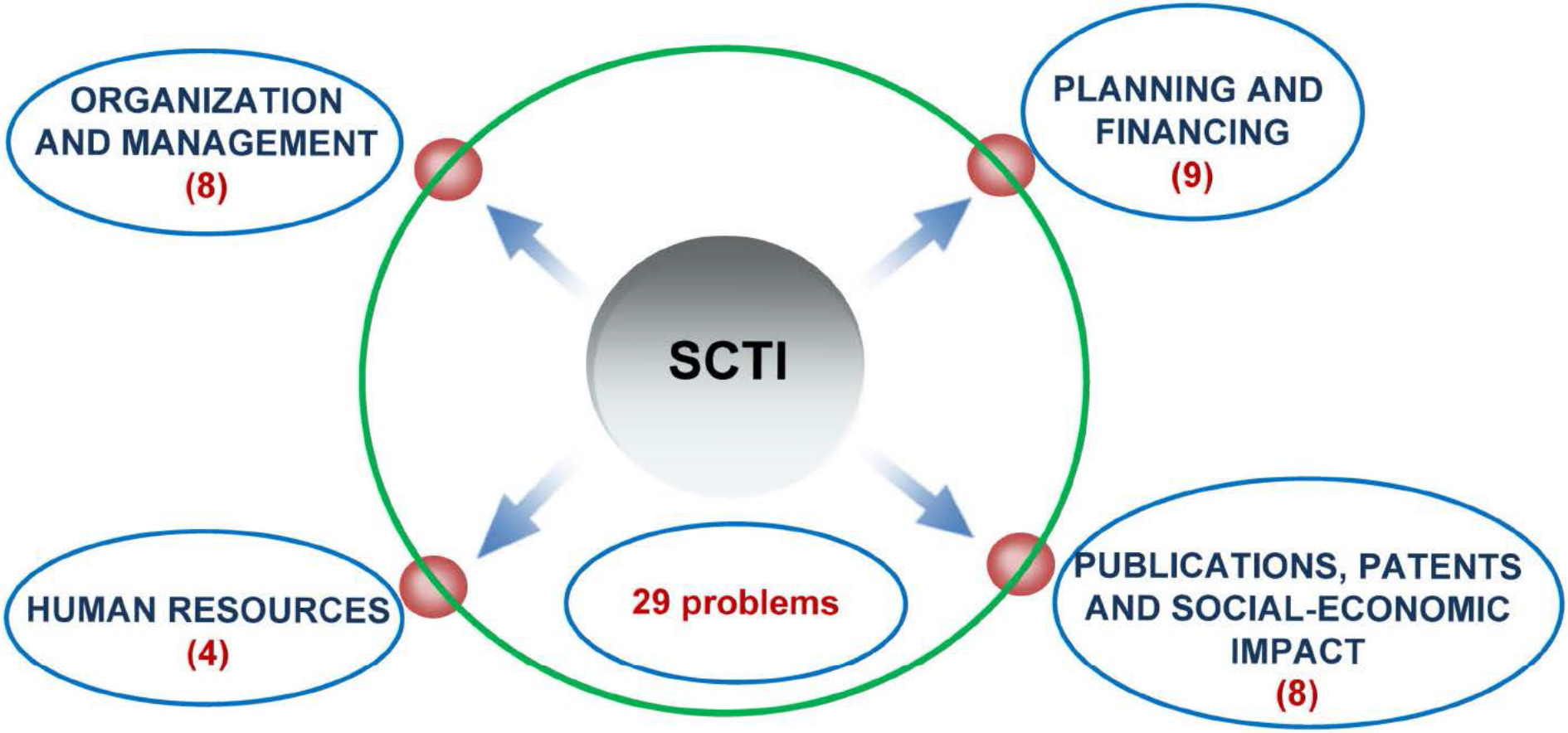
  - ✓ The Science Councils of ECTI (Resolution 165/2014).

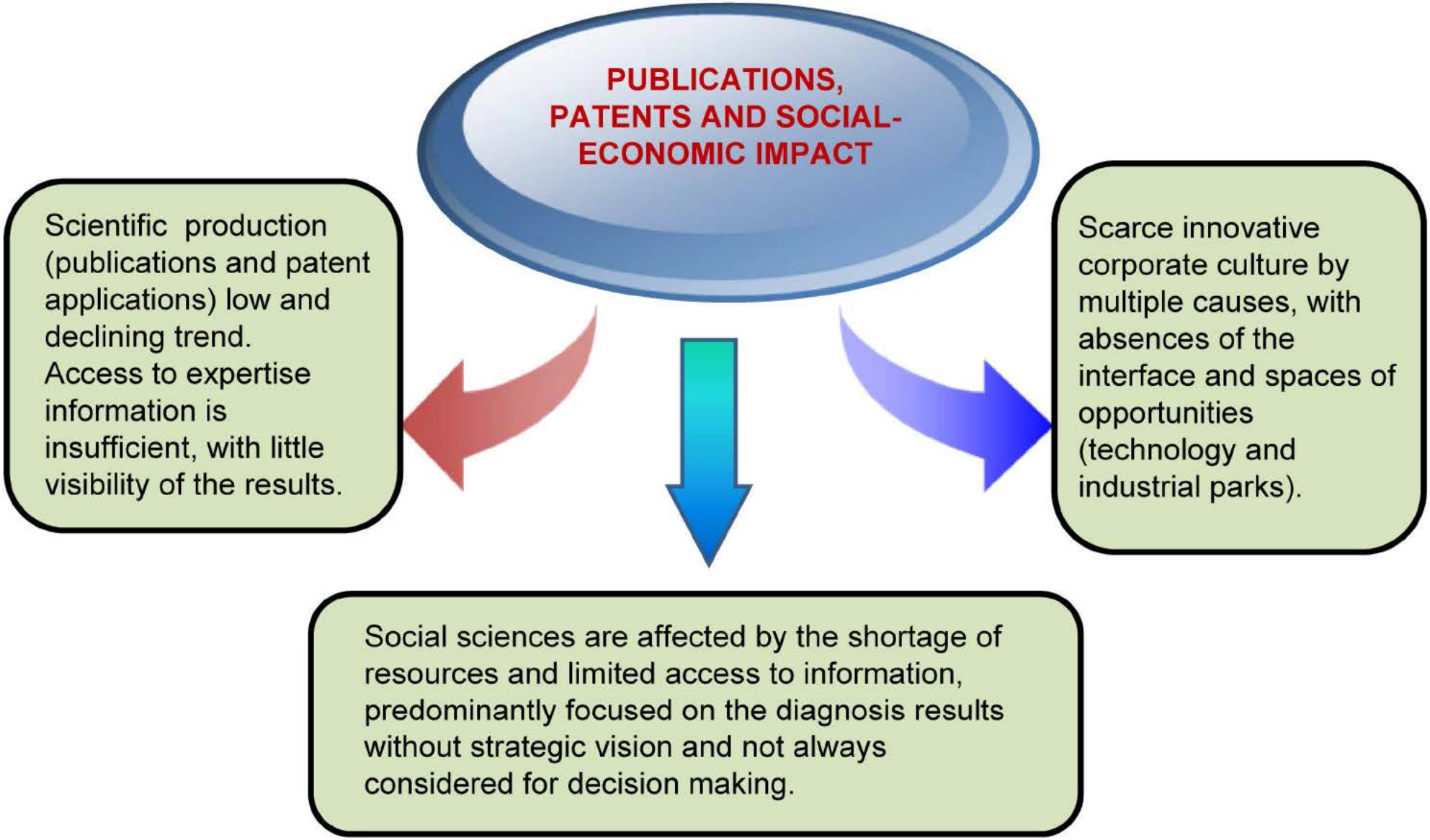
  - ✓ The regulation on the operation of the Science and Innovation Finance Fund (Resolution 166/2014).

# REORGANIZATION OF THE SCIT IN CUBA



# SCTI diagnosis

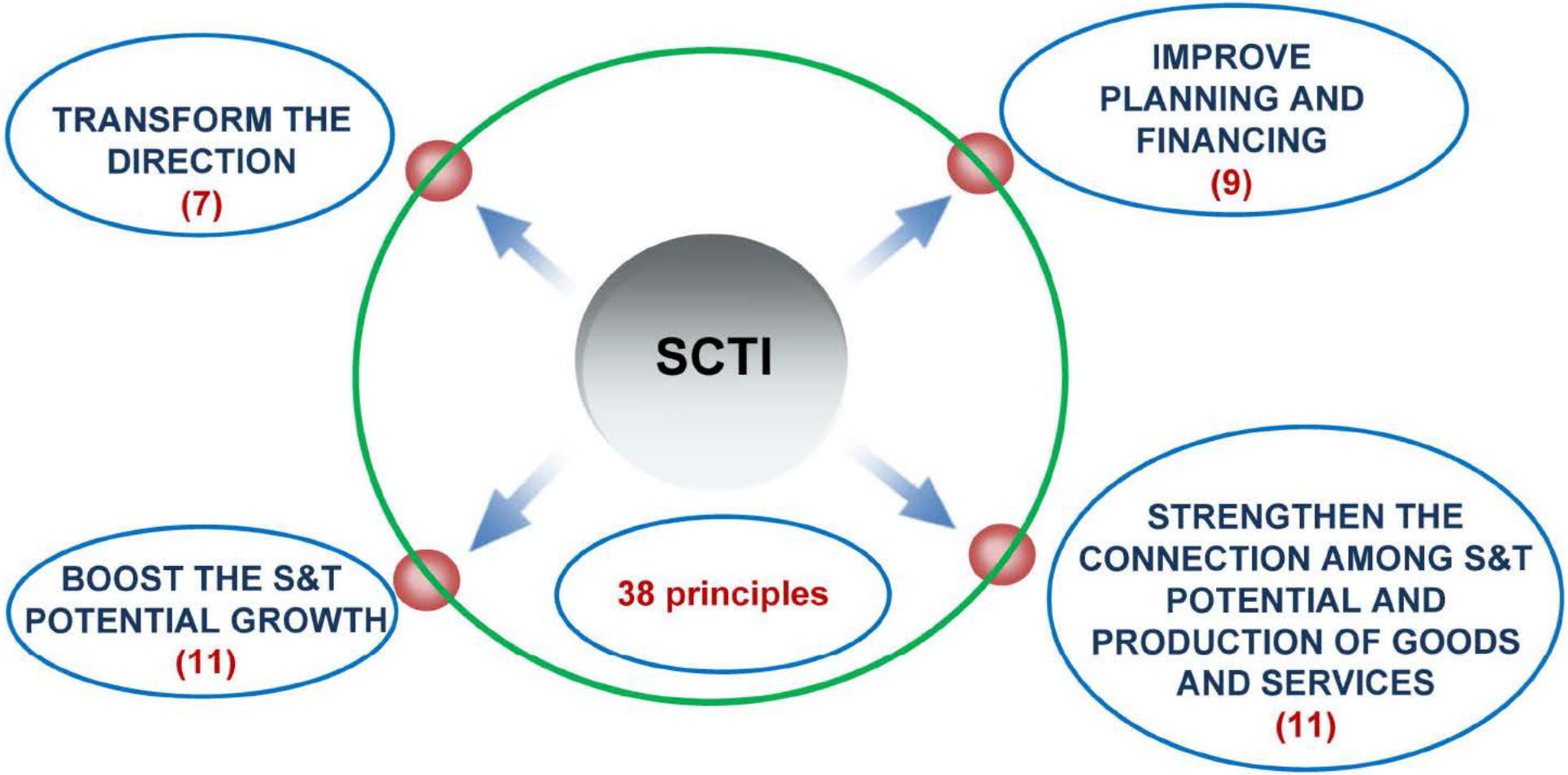



PUBLICATIONS, PATENTS AND SOCIAL-ECONOMIC IMPACT
Scientific production (publications and patent applications) low and declining trend. Access to expertise information is insufficient, with little visibility of the results.
Scarce innovative corporate culture by multiple causes, with absences of the interface and spaces of opportunities (technology and industrial parks).
Social sciences are affected by the shortage of resources and limited access to information, predominantly focused on the diagnosis results without strategic vision and not always considered for decision making.

## Achieving goals

- Proportion of GDP spent on R&D and S&T activities by about 1.5% and 2% respectively, with 50% of corporate contributions and increasing external financing.
- S&T staff in relation to the economically active population (25 per 1000).
- Index of researchers in relation with the economically active population (2 per 1000).
- 50% of doctors among researchers and university teachers.
- Invention coefficient (2 per 100.000 inhabitants).
- Inventions dependency rate (5%).
- Doubling annual graduation of doctors, depending on the specialties of interest.
- Doubling the proportion of high value-added exports of goods and services.
- Sustained growth of scientific publications above the average for Latin America and the Caribbean.

## Main axis of change (4 objectives)



# CONCLUSIONS

- In 1994 started the gradual implementation of the new Science and Technological Innovation System (SCIT). However, this move was incomplete and, although there have been successful experiences in some sectors, the integration of the SCIT with an effective national scope has not been achieved.

- In light of current changes in the economic and social model which take into account increased decentralization and business autonomy, as well as the strategic development forecast resulting from the 313 approved guidelines, requires a new institutional framework to make innovation the main engine that drives competitiveness and enable more effective integration into the global economy.

- The reorganization of the SCTI tries to recognize the differences and the dynamic interrelations between scientific research, technological development and innovation activities.

- But the challenge Cuba faces is to link them to provide the greatest possible economic and social impact.

# Key performance indicators

## ➢ Input indicators (human resources)

**Evolution of staff dedicated to R&D in Cuba (2006-2013)**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| Senior level | 44.827 | 46.025 | 59.600 | 60.358 | 68.661 | 80.953 | 69.803 | 56.431 |
| Of these researchers (a) | 5.491 | 5.236 | 5.525 | 5.448 | 4.872 | 4.618 | 4.655 | 4.477 |
| Mid-level | 19.096 | 14.819 | 19.165 | 19.368 | 13.879 | 12.283 | 12.678 | 15.998 |
| Others | 10.145 | 10.855 | 14.074 | 14.291 | 9.270 | 7.279 | 7.466 | 11.788 |
| Total (b) | 74.068 | 14.819 | 92.839 | 94.017 | 91.810 | 100.515 | 89.947 | 84.217 |

Source: Statistical Yearbook of Cuba 2013.
(a)It refers to researchers categorized
(b)Biotechnology Polo staff is included in 2011

## ➢ Input indicators (financial resources)

**Total expenditure on science and technology activities in million pesos (2006-2013)**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| R&D | 232,8 | 255,6 | 304,4 | 381,7 | 390,9 | 187,6 | 297,8 | 366,2 |
| Other scientific and technological activities | 153,0 | 168,0 | 199,0 | 254,5 | 260,6 | 125,1 | 130,4 | 244,1 |
| Total | 385,8 | 423,6 | 503,4 | 636,2 | 651,5 | 312,7 | 428,2 | 610,3 |

Source: Statistical Yearbook of Cuba 2013.

**Ratio Total expenses/GDP: ~0,68**

## ➢ Output indicators (scientific publications)

### Evolution of science and technology publications in SCI (2006-2013)

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| Total | - | - | - | 106 | 115 | 129 | 149 | 157 |

Source: Statistical Yearbook of Cuba 2013.

## ➢ Output indicators (patent applications)

### Applications for patents in Cuba (2006-2013)

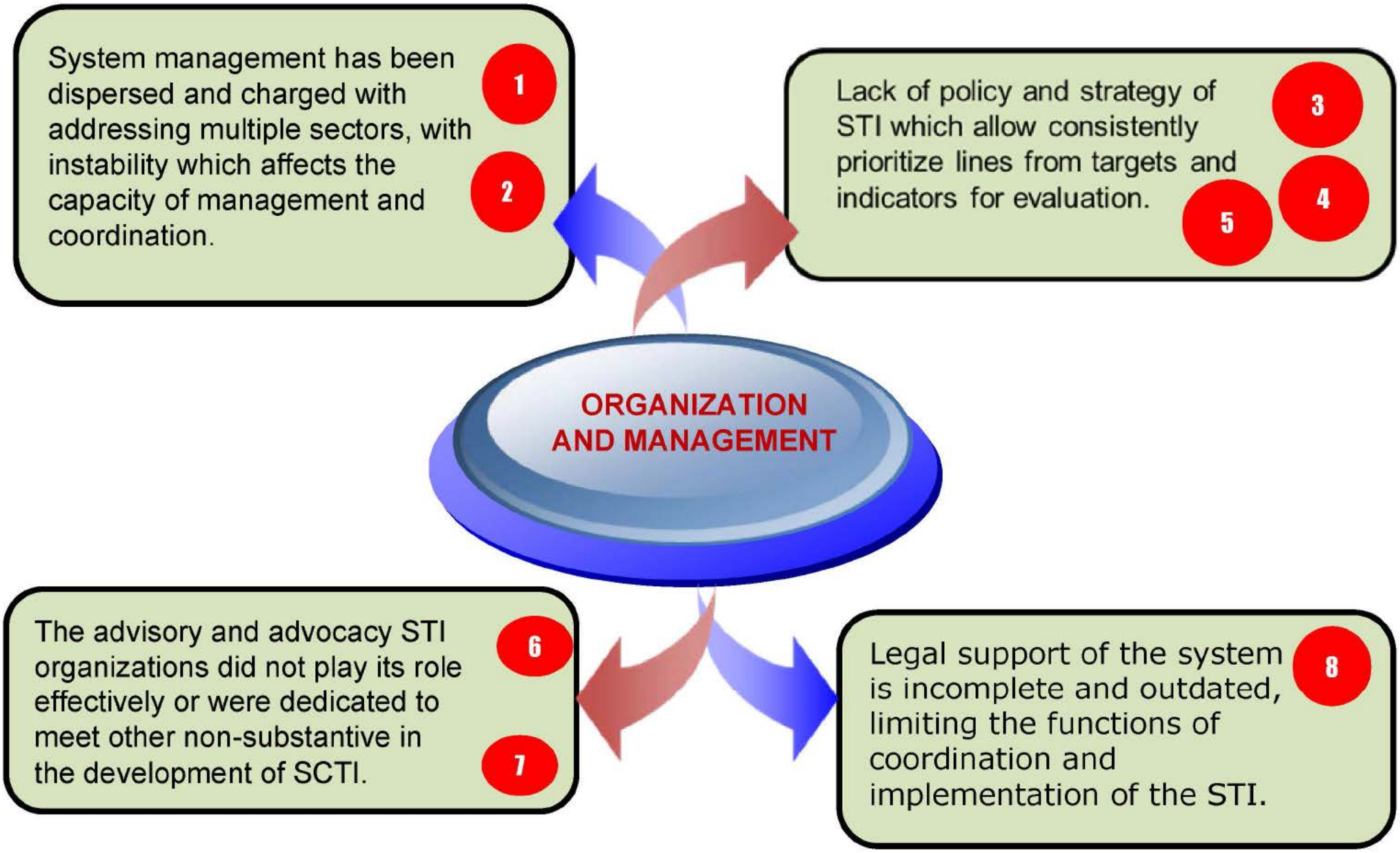
| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| National applications | 89 | 74 | 56 | 59 | 63 | 62 | 38 | 27 |
| Foreign applications | 163 | 210 | 156 | 172 | 203 | 184 | 140 | 141 |
| Total | 252 | 284 | 212 | 231 | 266 | 246 | 178 | 168 |
| Invention coefficient (a) | 0,84 | 0,66 | 0,50 | 0,52 | 0,56 | 0,55 | 0,34 | 0,24 |
| Dependency rate (b) | 1,83 | 2,84 | 2,79 | 2,92 | 3,22 | 2,97 | 3,68 | 5,22 |
| Auto-sufficiency rate (c) | 0,35 | 0,26 | 0,24 | 0,26 | 0,24 | 0,25 | 0,21 | 0,16 |

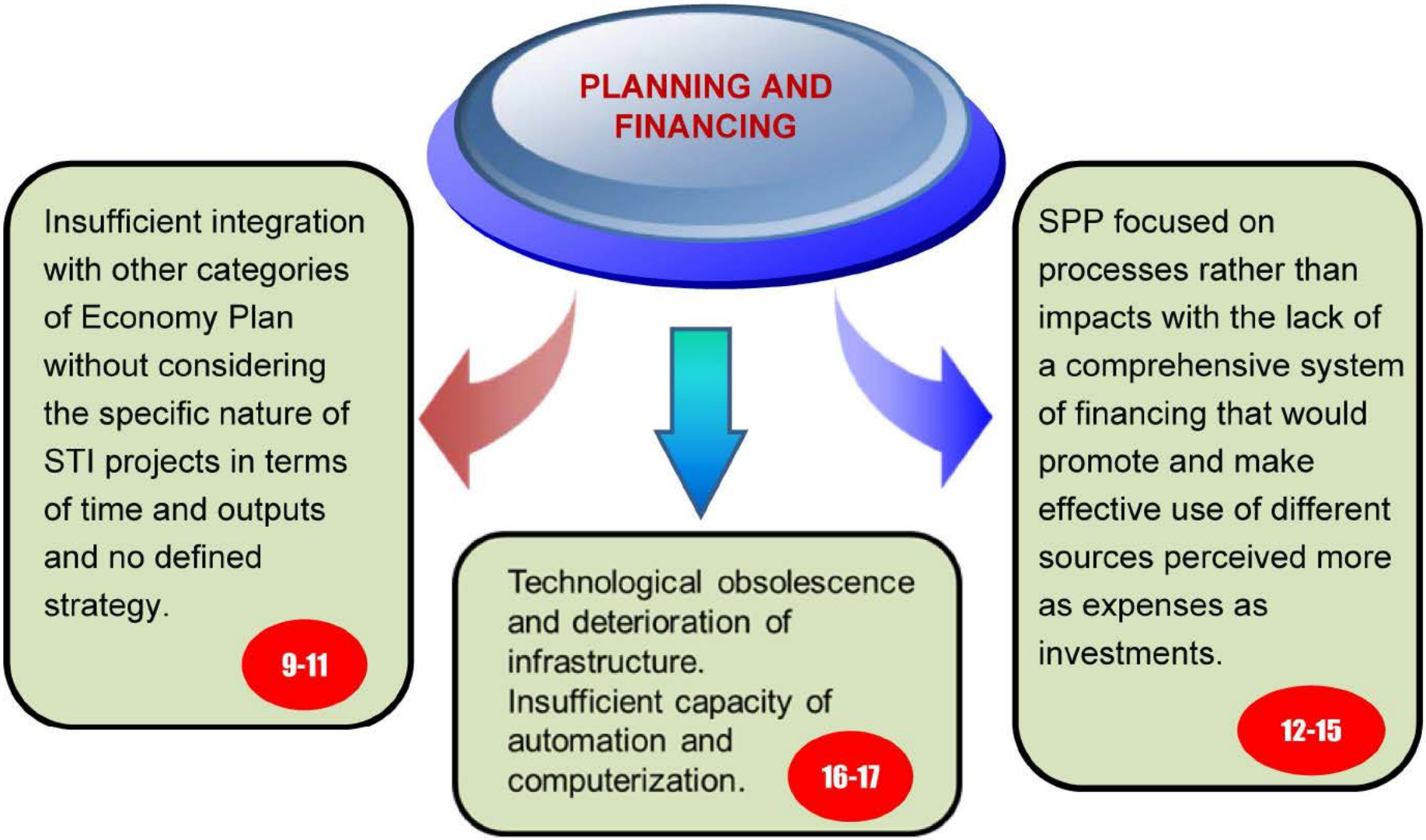
Source: Statistical Yearbook of Cuba 2013.

(a) Number of national applications per 100 000 inhabitants

(b) Ratio of foreign applications between national

(c) Ratio between national applications and the total number of applications


System management has been dispersed and charged with addressing multiple sectors, with instability which affects the capacity of management and coordination.
1
2
Lack of policy and strategy of STI which allow consistently prioritize lines from targets and indicators for evaluation.
3
4
5
ORGANIZATION AND MANAGEMENT
The advisory and advocacy STI organizations did not play its role effectively or were dedicated to meet other non-substantive in the development of SCTI.
6
7
Legal support of the system is incomplete and outdated, limiting the functions of coordination and implementation of the STI.
8

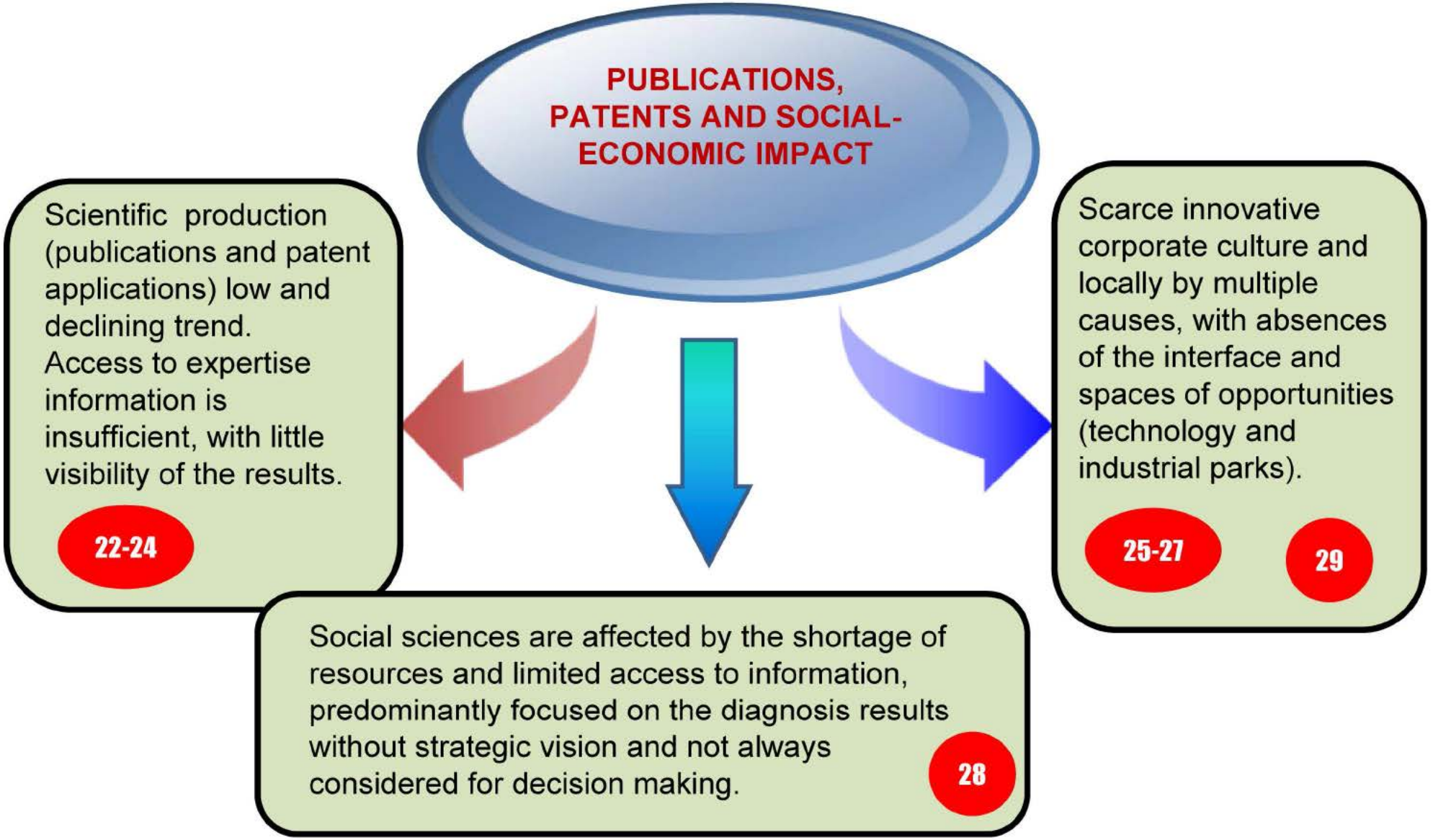

PLANNING AND FINANCING
Insufficient integration with other categories of Economy Plan without considering the specific nature of STI projects in terms of time and outputs and no defined strategy.
9-11
Technological obsolescence and deterioration of infrastructure.
Insufficient capacity of automation and computerization.
16-17
SPP focused on processes rather than impacts with the lack of a comprehensive system of financing that would promote and make effective use of different sources perceived more as expenses as investments.
12-15

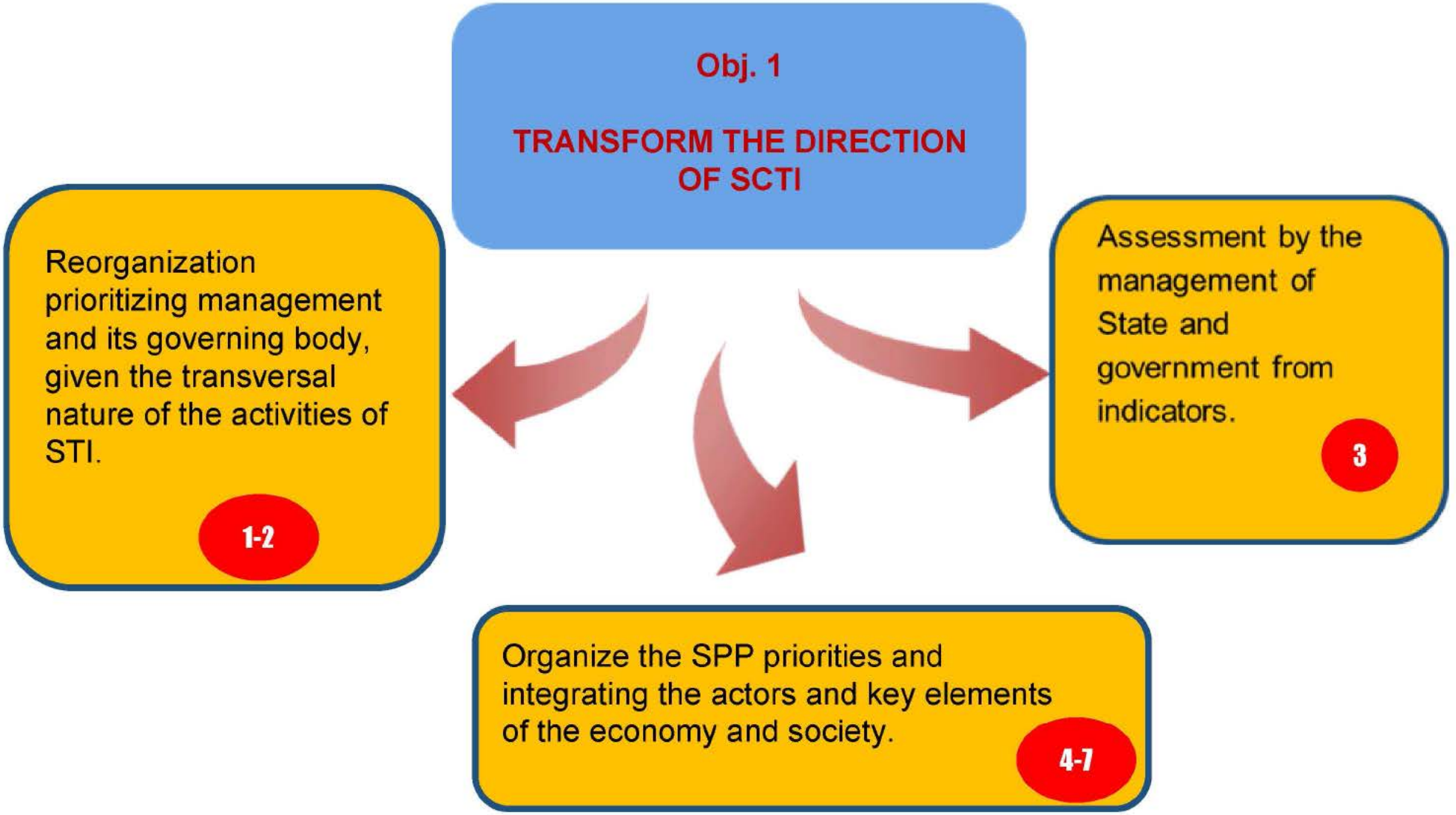

The training of doctors has lacked an explicit policy. The distribution does not correspond to the priorities. The proportion of researchers and academics with doctorates is low. There are not scholarships for doctoral programs to train young graduates, both at home and abroad, in the fields of interest.

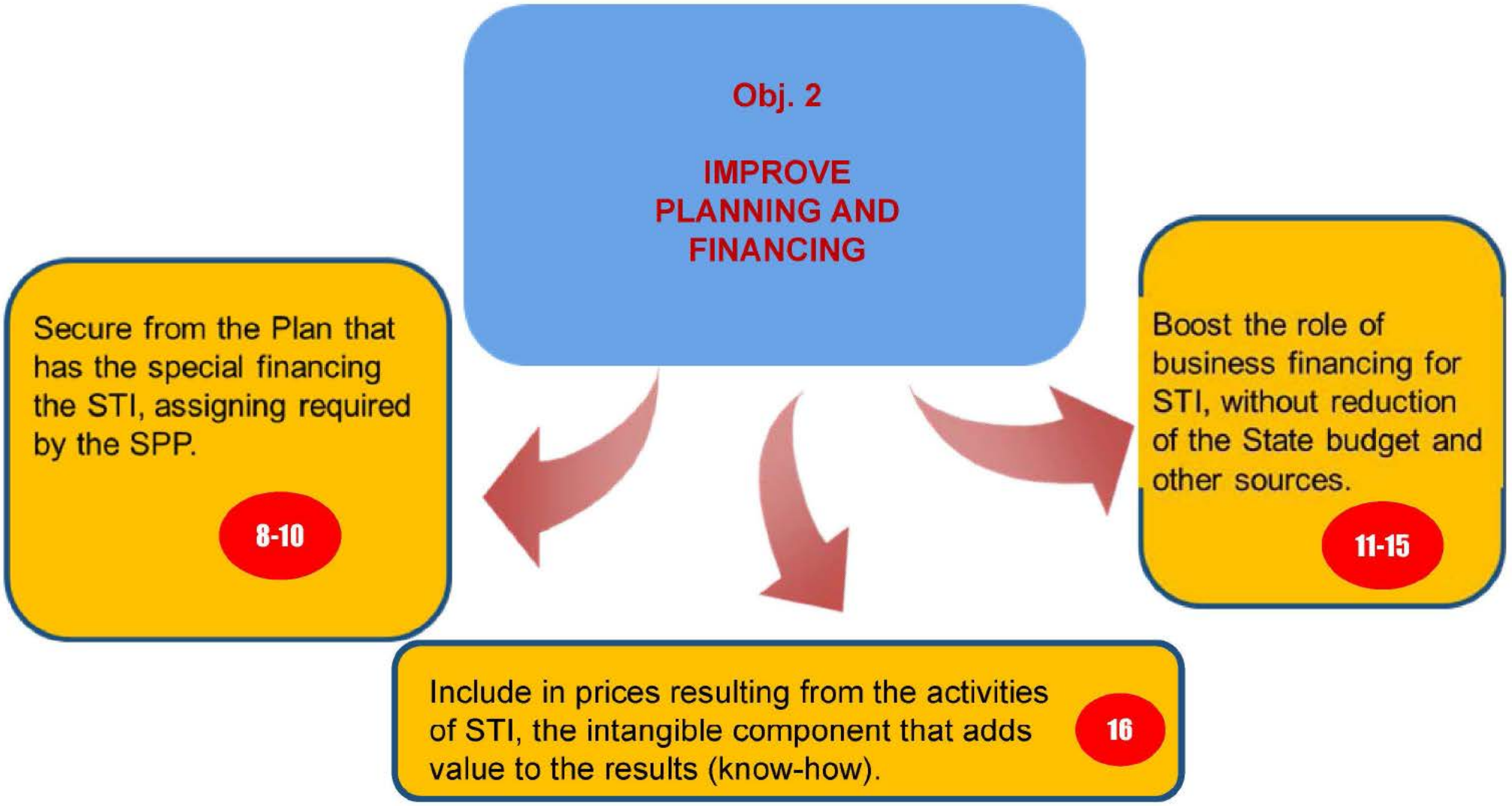
2

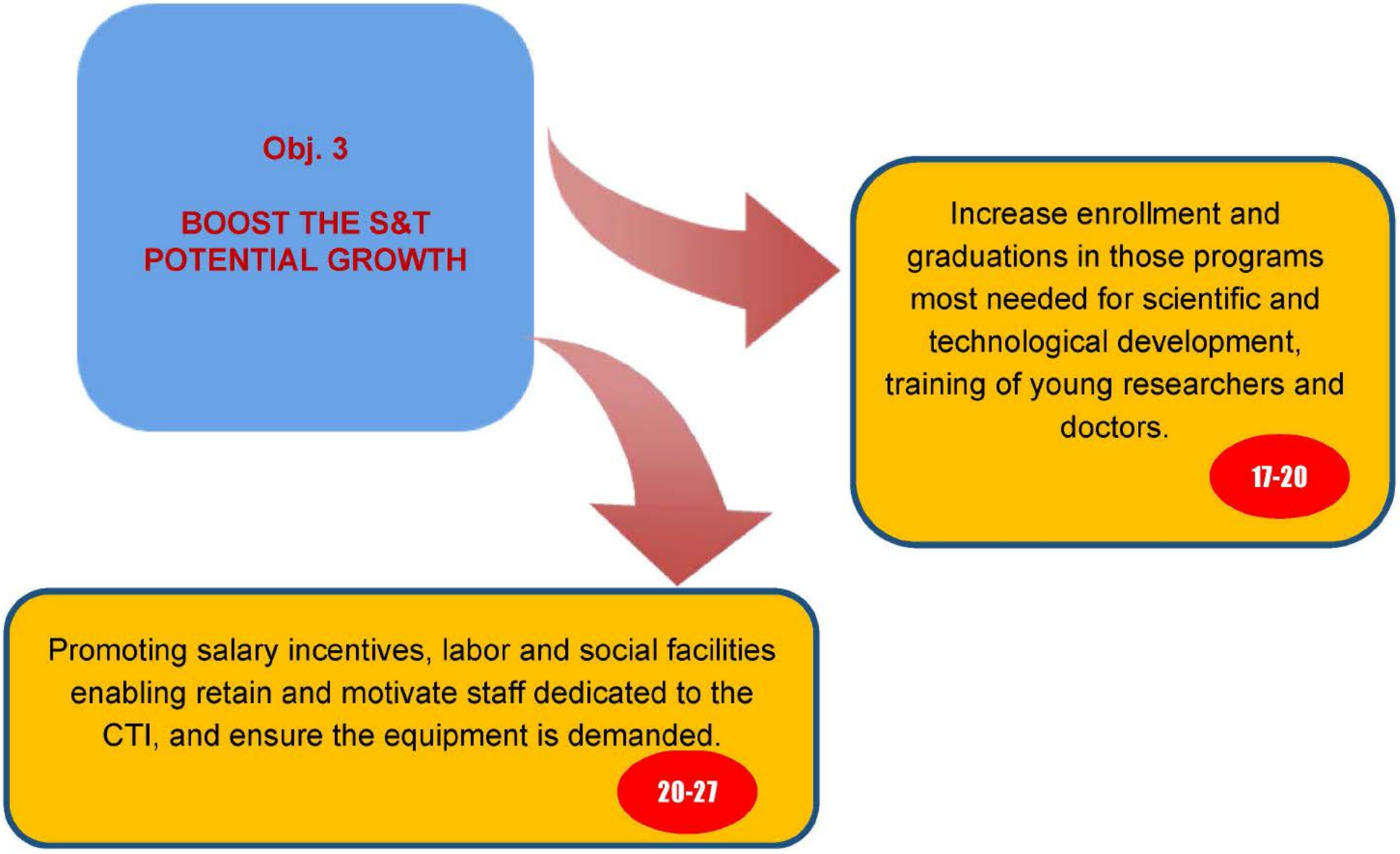
Decreasing dynamic staff, with growing exodus by inadequate pay and conditions, and the contradiction of high intellectual level of technical training and limited presence of high technology content and low investment in STI without warranty of generational replacement.

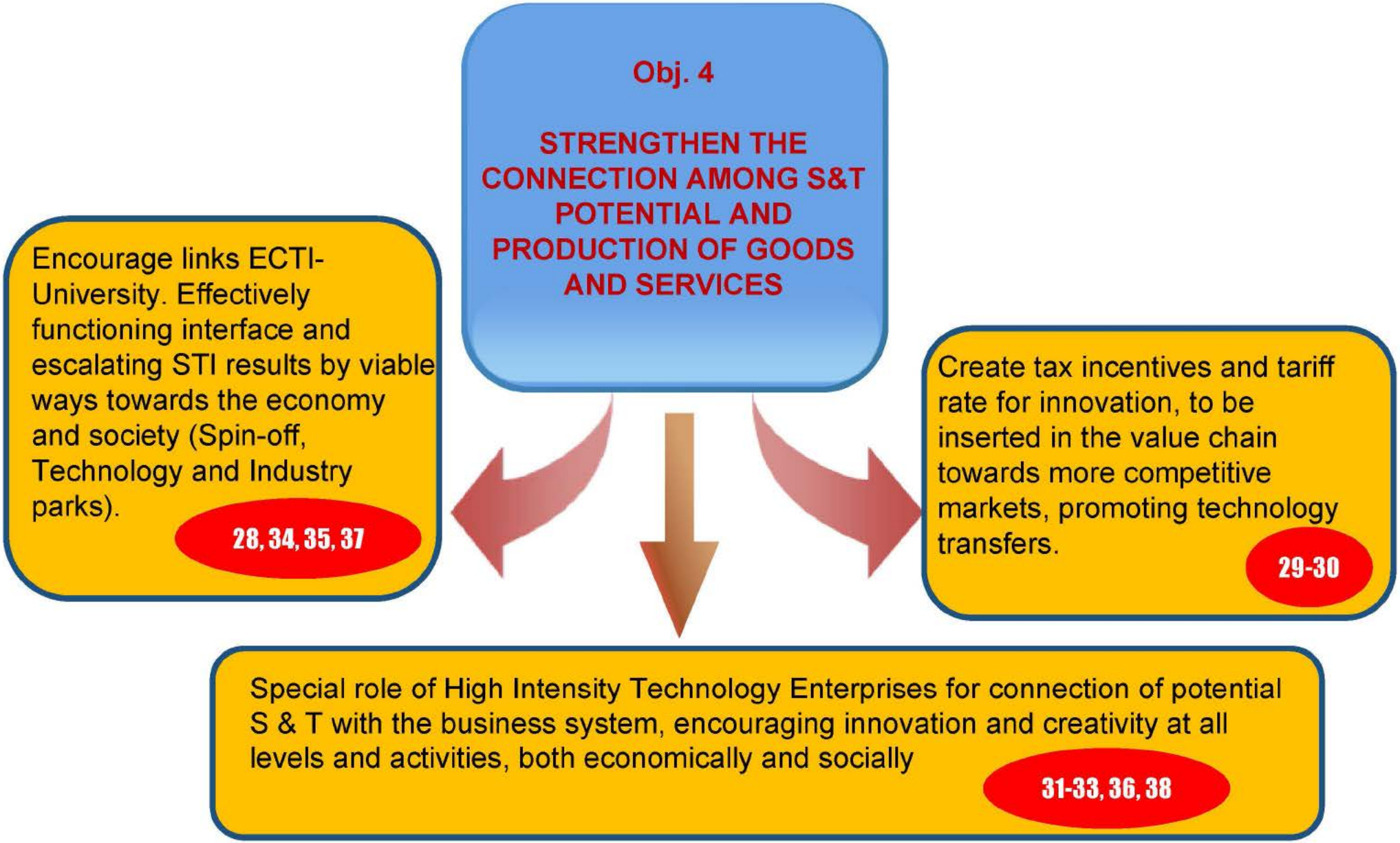
18-20


PUBLICATIONS, PATENTS AND SOCIAL-ECONOMIC IMPACT
Scientific production (publications and patent applications) low and declining trend. Access to expertise information is insufficient, with little visibility of the results.
22-24
Social sciences are affected by the shortage of resources and limited access to information, predominantly focused on the diagnosis results without strategic vision and not always considered for decision making.
28
Scarce innovative corporate culture and locally by multiple causes, with absences of the interface and spaces of opportunities (technology and industrial parks).
25-27
29


Obj. 1
TRANSFORM THE DIRECTION OF SCTI
Reorganization prioritizing management and its governing body, given the transversal nature of the activities of STI.
1-2
Assessment by the management of State and government from indicators.
3
Organize the SPP priorities and integrating the actors and key elements of the economy and society.
4-7


Obj. 2
IMPROVE PLANNING AND FINANCING
Secure from the Plan that has the special financing the STI, assigning required by the SPP.
8-10
Boost the role of business financing for STI, without reduction of the State budget and other sources.
11-15
Include in prices resulting from the activities of STI, the intangible component that adds value to the results (know-how).
16


Obj. 3
BOOST THE S&T POTENTIAL GROWTH
Increase enrollment and graduations in those programs most needed for scientific and technological development, training of young researchers and doctors.
17-20
Promoting salary incentives, labor and social facilities enabling retain and motivate staff dedicated to the CTI, and ensure the equipment is demanded.
20-27


Obj. 4
STRENGTHEN THE CONNECTION AMONG S&T POTENTIAL AND PRODUCTION OF GOODS AND SERVICES
Encourage links ECTI-University. Effectively functioning interface and escalating STI results by viable ways towards the economy and society (Spin-off, Technology and Industry parks).
28, 34, 35, 37
Create tax incentives and tariff rate for innovation, to be inserted in the value chain towards more competitive markets, promoting technology transfers.
29-30
Special role of High Intensity Technology Enterprises for connection of potential S & T with the business system, encouraging innovation and creativity at all levels and activities, both economically and socially
31-33, 36, 38